REMARKS

Claims 22, 29-31, 35, and 58 have been amended. Claims 60-62 have been added. Claims 22-35, 58, and 60-62 are now pending. The Title of the Invention has been amended to correspond more closely to the pending claims. Applicant reserves the right to pursue the original claims and other claims in this and other applications. Please reconsider the above-referenced application in light of the amendments and following remarks.

Claims 30, 31, and 35 stand rejected under 35 U.S.C. § 112, second paragraph for insufficient antecedent basis. Claims 30, 31, and 35 have been amended to maintain proper antecedent basis. The 35 U.S.C. § 112, second paragraph, rejection for claims 30, 31, and 35 should be withdrawn.

Claims 22-35 and 58 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No.: 5,739,579 ("Chiang") in view of U.S. Patent No.: 6,016,000 ("Moslehi"). The rejection is respectfully traversed.

The cited references do not teach or suggest the subject matter of independent claims 22, 29, and 58. Specifically, the cited references do not teach or suggest "forming a conductive plug in said first contact opening, wherein said conductive plug is in contact with said first insulating layer," as recited in claim 22. The cited references do not teach or suggest "forming a top heat-radiating layer comprising aluminum nitride on an entire upper surface portion of said copper conductor," as recited in claim 22. The cited references do not teach or suggest "forming a heat-radiating layer comprising aluminum nitride across an entire upper surface portion of said first conductive plug; and depositing a second conductive plug on said heat-radiating layer in electrical contact with said first conductive plug," as recited in claim 29. Similarly, the cited references do not teach or suggest "forming a

heat-radiating layer across an entire upper surface portion of said second conductive plug," as recited in claim 58.

The Office Action asserts that Chiang primarily discloses all of the subject matter of claims 22-35 and 58 in FIGS. 23-25. This is not true. Chiang's FIG. 25 illustrates a first conductive plug 342 surrounded by a barrier layer 340 in a first insulating layer 322. Chiang's plug 342 is not in contact with the first insulating layer 322. As such, Chiang does not disclose or suggest "forming a conductive plug . . . [that] is in contact with said first insulating layer," as recited in claim 22.

The Office Action further alleges that Chiang's element 392 is analogous to Applicant's claimed heat-radiating layer. Applicant's claimed heat-radiating layer 60 is formed on the entire upper surface of a conductive plug 56 (Applicant's FIG. 9). Chiang's etch-stop layer 392 is not formed across the entire upper surface of copper conductor 394 (FIG. 25). As such, Chiang does not teach or suggest "forming a top heat-radiating layer comprising aluminum nitride on an entire upper surface portion of said copper conductor," as recited in claim 22, or "forming a heat-radiating layer comprising aluminum nitride across an entire upper surface portion of said first conductive plug," as recited in claim 29, or "forming a heat-radiating layer across an entire upper surface portion of said second conductive plug," as recited in claim 58.

Moreover, Chiang's conductive plug 397 is not formed on heat-radiating layer 392. Conductive plug 397 is formed on barrier layer 396. Chiang's barrier layer 396 is formed on insulating layer 391 and portions of copper conductor 394 and barrier layer 393. Accordingly, Chiang does not teach or suggest "depositing a second conductive plug on the heat-radiating layer in electrical contact with said first conductive plug," as recited in claim 29.

Moslehi is relied upon for disclosing a method of forming an etch stop/heat-radiating passivation layer of aluminum nitride, and adds nothing to rectify the deficiencies of Chiang. The Office Action asserts that it would have been obvious to substitute Moslehi's aluminum nitride passivation layer for Chiang's silicon nitride etch-stop layer, since Moslehi discloses AlN is an alternative choice. Applicant respectfully submits, however, that there is no motivation to combine the references and that they teach away from the proposed combination.

Chiang is directed to forming a copper interconnect structure which is thinner than an aluminum interconnect while giving the same or lower resistance (col. 3, lines 28-30). Another benefit of Chiang's methods is that the depth of the interconnect channels is easier to control since the first dielectric layer acts as an etch stop while etching the second dielectric layer (col. 3, lines 22-24). Moslehi, in contrast, discloses that a "technical advantage of the present invention is improved interconnect metal lead and plug conductances due to elimination of the need for all (but one) barrier layers (all via-level barrier layers can be eliminated." (Col. 8, lines 2-6) (emphasis added). To this end, Moslehi discloses a hermetically-sealed free space medium structure. The only thing these two inventions share in common is the substrate on which they are formed. There is no motivation to combine such different structures.

Further, Moslehi teaches a structure with just one via-barrier level. All of the other via-level barrier levels are eliminated. Chiang, in contrast, teaches via-level barriers such as barrier 360, 393, and 396 (FIG. 25). Chiang's interconnect structure has a plurality of via-barriers. Accordingly, the two references teach away from each other since one reference discloses the use of a plurality of via-barriers and the other reference discloses using only one via-barrier.

Still further, even if the references are properly combinable, they still do not disclose or suggest a method of forming a copper interconnect structure by "forming a first contact opening into a first insulating layer . . . forming a conductive plug in said first contact opening, wherein said conductive plug is in contact with said first insulating layer; forming a second insulating layer . . . forming a second contact opening in said second insulating layer; forming a barrier layer . . . forming a copper conductor over said barrier layer; and forming a top heat-radiating layer comprising aluminum nitride on an entire upper surface portion of said copper conductor," as recited in independent claim 22.

The references do not disclose or suggest a method of forming an interconnect structure by "forming a contact opening in an insulating layer . . . forming a first conductive plug . . . forming a heat-radiating layer comprising aluminum nitride across an entire upper surface portion of said first conductive plug; and depositing a second conductive plug on said heat-radiating layer in electrical contact with said first conductive plug," as recited in independent claim 29.

Similarly, the references do not disclose or suggest a method of forming a copper interconnect structure by "forming a first contact opening into a first insulating layer . . . forming a first conductive plug . . . forming a second insulating layer . . . forming a second contact opening . . . forming a barrier layer . . . forming a second conductive plug over said barrier layer; and forming a heat-radiating layer across an entire upper surface portion of said second conductive plug," as recited in independent claim 58.

Claim 23-28 depend from claim 22 and should be similarly allowable along with claim 22 for at least the reasons provide above, and on their own merits. Claim 30-35 depend from claim 29 and should be similarly allowable along with claim 29 for at least the reasons provided above, and on their own merits.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

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